APPENDIX F: QUINAULT RIVER TIME-LAPSED PHOTOGRAPHY

PURPOSE

Cameras were installed on October 27, 2001 to take time-lapsed photography of the Quinault River during the 2001-2002 winter flood season at two sites along Graves Creek Road. The time-lapsed photography provides researchers and biologists at the Bureau of Reclamation, Olympic National Park, and the Quinault Indian Nation information to better understand the process linkages of flooding, bank erosion, and the transport and deposition of large woody debris. This will help provide resource decision makers with information to help implement fish habitat structures that both improve fisheries while also protecting important infrastructures such as roads and bridges.

BACKGROUND

In 2001, Reclamation was asked by the National Park Service and Quinault Indian Tribe to investigate bank erosion issues associated with river and hillslope processes along Graves Creek Road. Although the main sockeye restoration study was later moved into the downstream study reach below the Forks and Graves Creek Road, time-lapse cameras were installed along Graves Creek Road prior to this adjustment in study reach. Information gathered from these two sites along Graves Creek Road is still very useful to the downstream study reach to show how the river interacts with large woody debris during high flows.

The cameras utilized were 35-mm cameras (Nikon N90S) that have programmable backs to allow for "unmanned" operation except for changing of the film. At each site one photograph per day was taken. This allowed local staff from National Park Service to only change the film once per month, which was necessary due to the difficult access at this site. The more photographs that are taken per day, the more often the film must be changed in the cameras.

CAMERA LOCATIONS

Two camera locations were chosen along Graves Creek Road, which runs along the south (left looking downstream) side of the east fork of the Quinault River (upstream of the Forks). Site 1 represents an area where the left bank adjacent to the park road is made up of primarily bedrock and is therefore naturally protected (Figure 1 and 3). Site 2 represents an area where the river is eroding the left bank along the park road and rock protection has been used to protect the bank (Figure 2 and 4).

Figure 1. Planview location of camera 1.

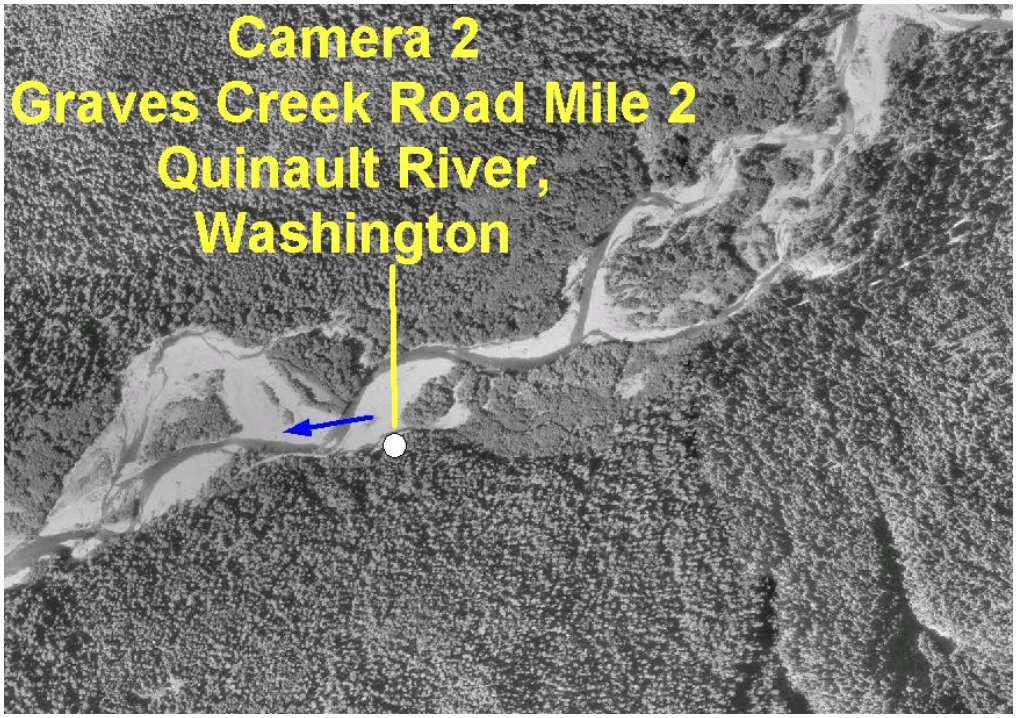

Figure 2. Planview location of Camera 2.

Figure 3. Site 1 River View - Looking upstream at Quinault River at upstream site with bedrock banks adjacent to park road. The goal of the camera is to observe natural interaction between woody debris transport and gravel bar formation.

Figure 4. Site 2 River View -Looking downstream at Quinault River from camera 2 where barbs have been placed and additional bank protection is likely to be implemented, about 2 miles downstream from Site 1. The goal of the camera is to observe any additional impacts from high flow events and migration of the channel due to existing barb structures or additional bank protection if placed.

River Flows during Camera Operation

There is no river gage presently in operation on the Upper Quinault River (above Lake Quinault). The closest gage is located at the outlet of Lake Quinault. This gage provided an estimate of the occurrence of floods during the time-lapse photo project and a rough idea of the magnitude of flow, at least in a relative sense. In other words, by determining if a flow value at the gage was near a 2-year flood, it could be estimated that the flow at the time-lapse photo location was also a "2-year flood" when the photos were taken during the same flood peak. The actual flow at the time-lapse photo locations would likely be less than at the outlet of Lake Quinault because the locations are above the confluence of the two main stems of the Quinault River. Additionally, the timing of when the peak of the flood occurred at the time-lapse photo locations should occur sooner than when it occurs at the outlet of Lake Quinault due to the travel time of the flood wave. Based on a simple approach of observing when the highest stage occurred at the time-lapse photography locations versus when it was recorded at the gage outlet, there appeared to be an approximately one day difference in flood peak occurrence for the time period noted in figure 5.

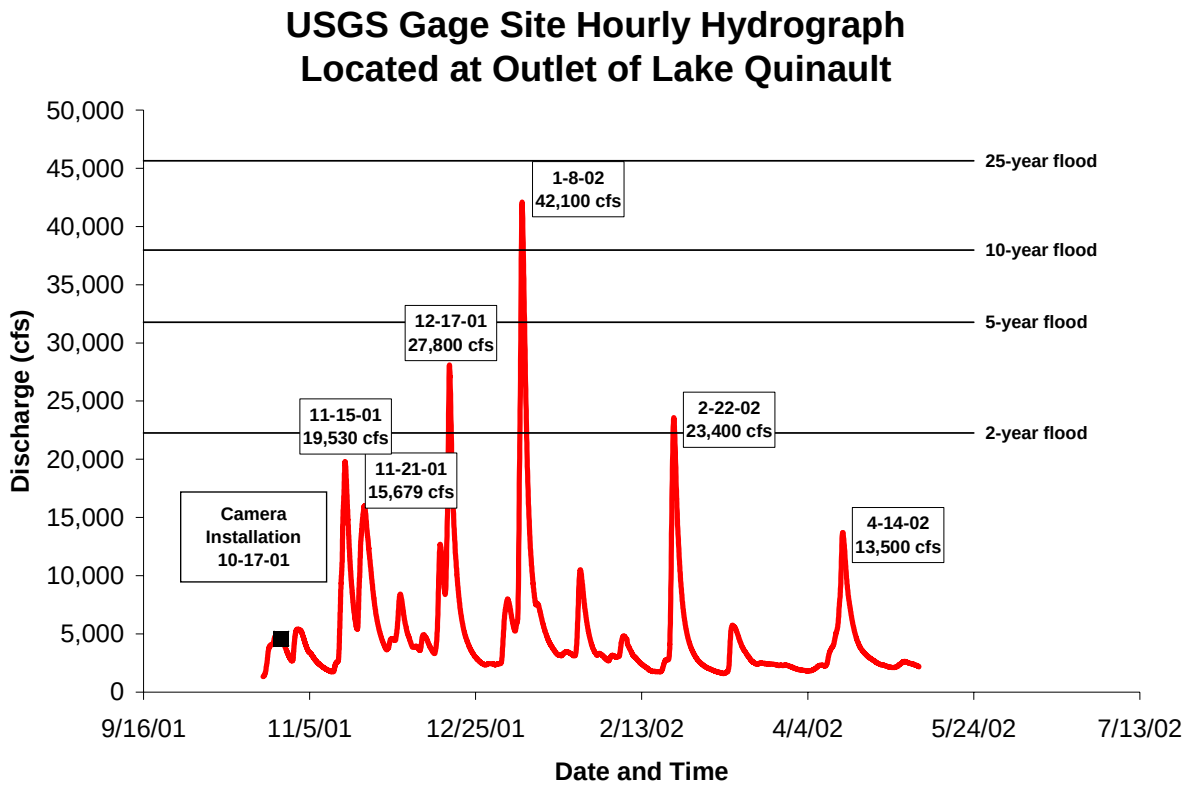

Figure 5. Hourly flow hydrograph for period of time-lapse photography. Note that data was downloaded in a provisional state and may have been updated by USGS since 2002.

Videos of Photographs

A time-lapse video was composed from the photographs taken for each of the two camera sites. These videos are available upon request from Reclamation. Both videos document a hydrograph that shows the mean daily flow recorded at the outlet of Lake Quinault, or in the case when floods occur, the video documents the peak flow recorded from the hourly gage data at the outlet of Lake Quinault.

Summary Photographs

Each site showed significant transport and reworking of gravel bars and large woody debris. The video is the best way to see the day to day dynamics, but the before and after photographs are shown below for each site, along with an in-between photograph time showing the highest flood recorded at the USGS gage on January 8, 2002 (highest stage observed at each camera site on January 7, 2002).

CAMERA 1 SUMMARY PHOTOGRAPHS (Date recorded shown on photograph)

CAMERA 2 SUMMARY PHOTOGRAPHS (Date recorded shown on photograph)